

An artistic rendering of the Hayabusa spacecraft in space. The spacecraft, with its gold-colored body and large blue solar panel arrays, is shown from a low angle, appearing to approach a large, grey, cratered asteroid. In the background, the Earth is visible as a blue and white sphere. The scene is set against a deep blue and black starry sky. The title text is overlaid in the center.

Lessons Learned on Hayabusa

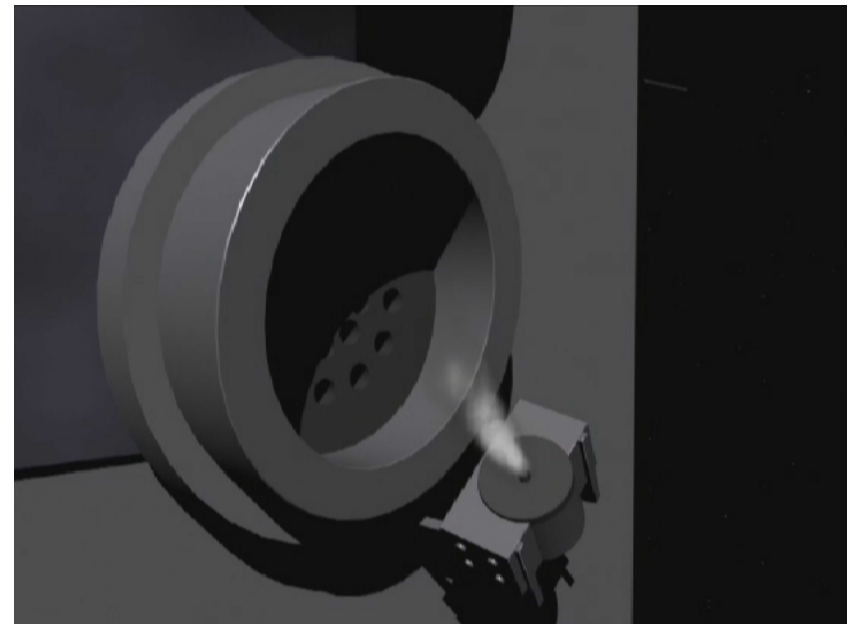
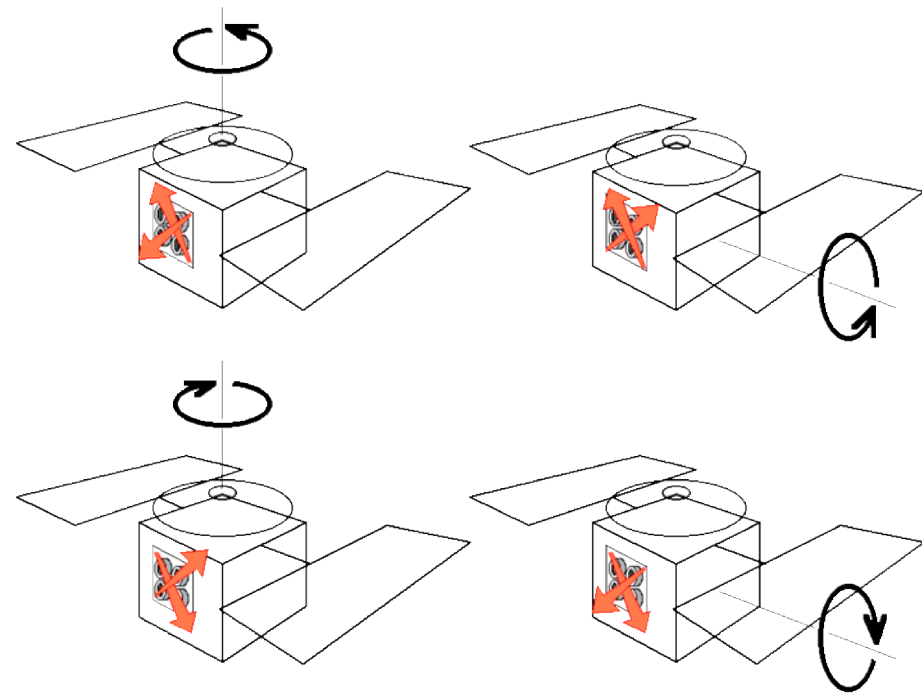
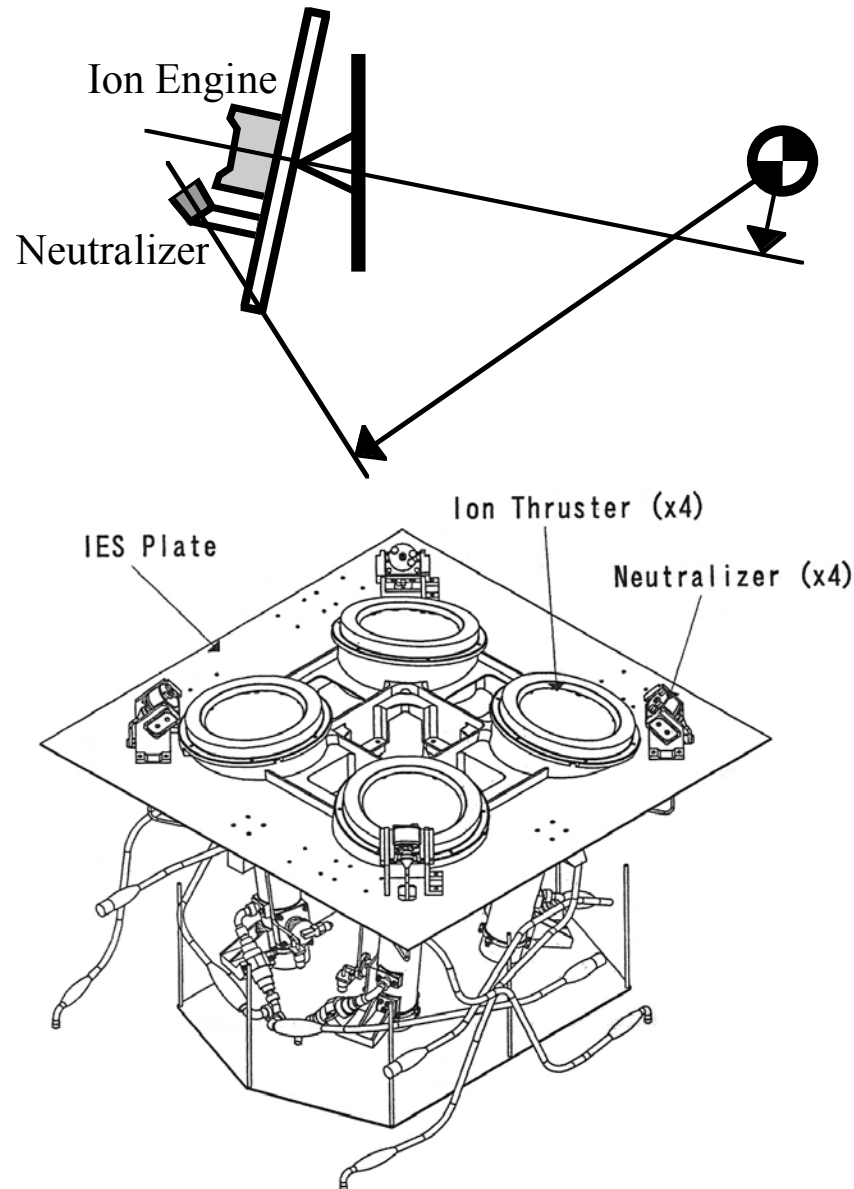
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Malfunctions and Counter Measures on Attitude Control

Technology	Status	Counter Measures	Date
Attitude Control	1st loss of three Reaction Wheels	Establishment of 3-axis attitude control by two RWs	July 2005 before Rendezvous
	2nd loss of three Reaction Wheels	Establishment of 3-axis attitude control by short pulse operation of 2-prop thrusters	Sep 2005 during Rendezvous
	Loss of 2-prop thrusters	Establishment of 3-axis attitude control by a RW and Ion Engines	Nov 2005 during Rendezvous

Attitude Control by Xenon Cold Gas-Jet

Jan - April 2006



Homeward Journey by Ion Engines from Apr 07

Malfunction 2-prop. Thrusters

Two of three Reaction Wheels

Space Operation

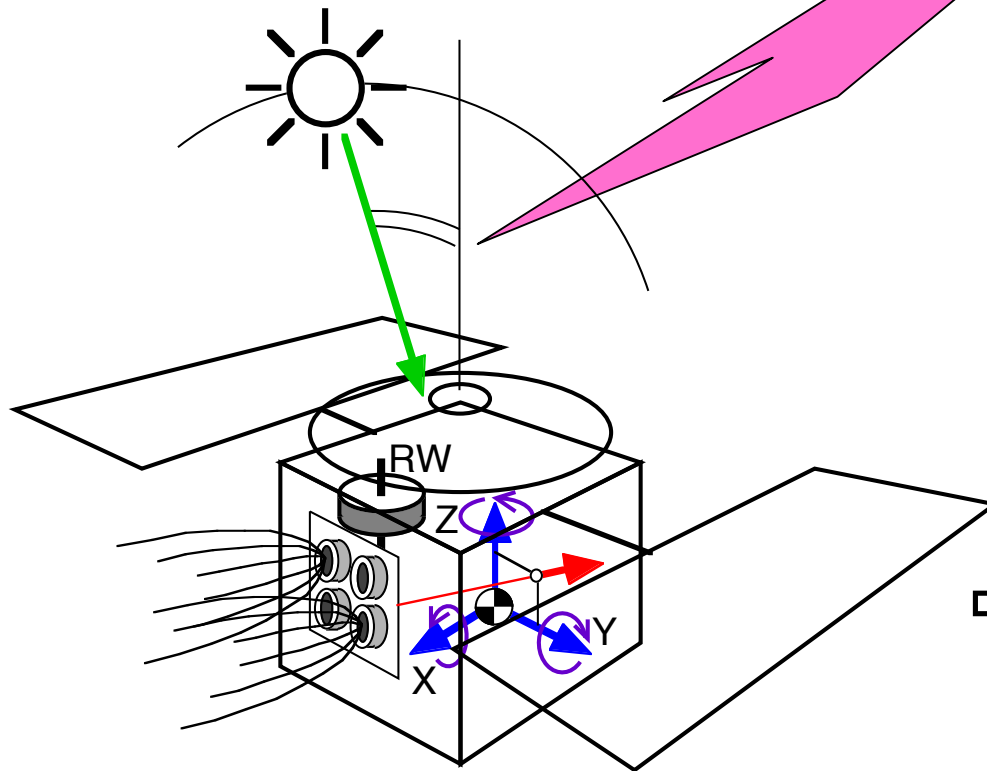
ΔV by Ion Engines

Thrust Vector Control for Y & Z-axis torques

Solar Pressure Torque around X-axis

Single Reaction Wheel for non-spin stabilization

Xenon Cold Gas Jets for Attitude Control

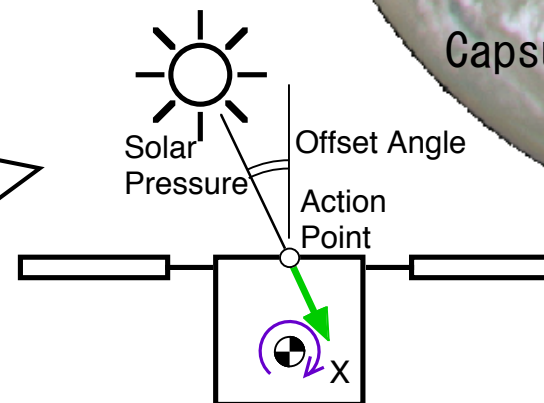


SSOC

Track & Control
Orbit Determine
Orbit Plan



Capsule Recovery



Malfunctions and Counter Measures on Ion Engines

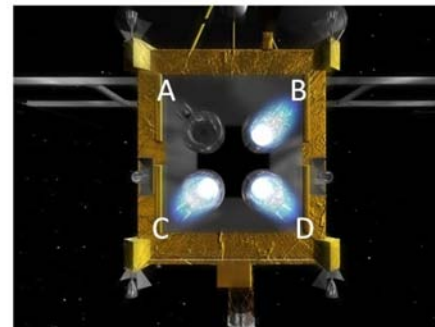
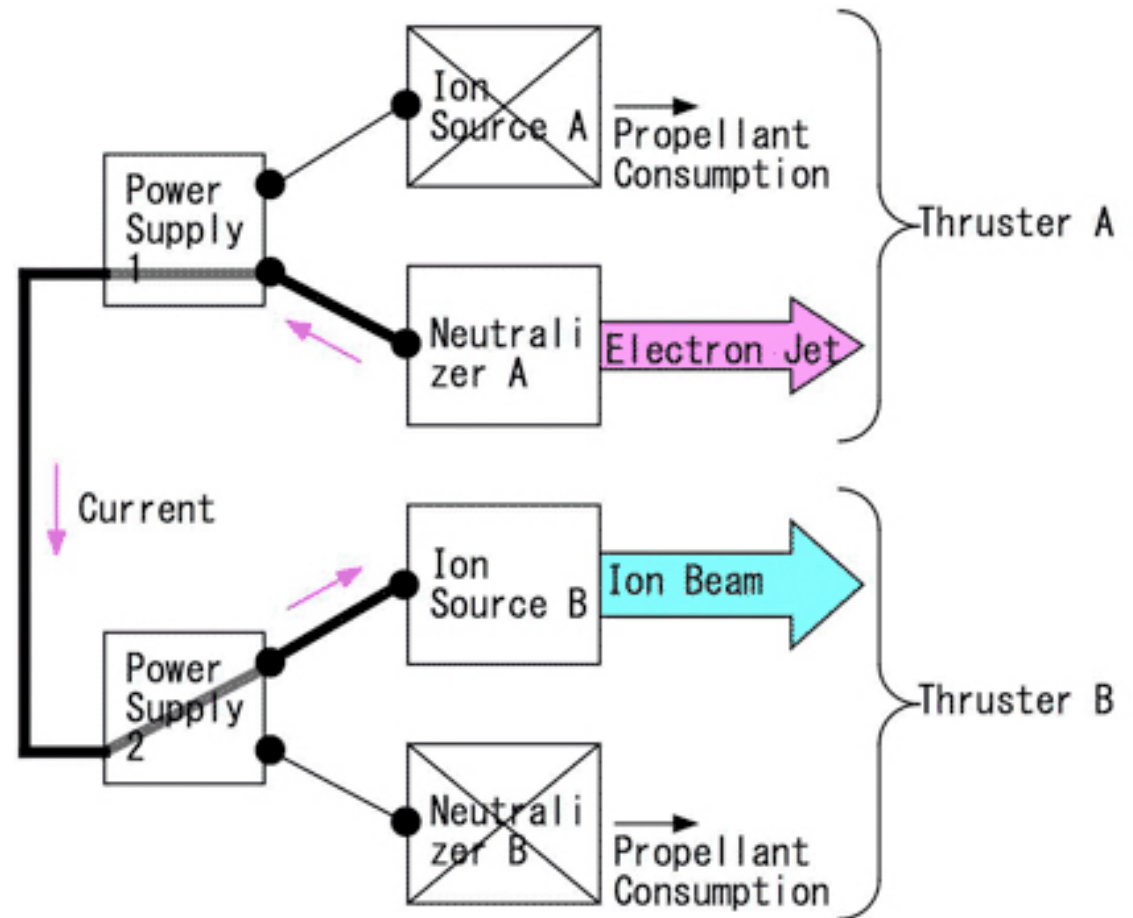
Technology	Status	Counter Measures	Date
Delta-V	Loss of ITR-A	N/A	July 2003 after Launch
	Loss of all ITRs	Combined operation IS-B and Neut-A	Nov 2009 during Return delta-V

Cross Connected Operation of Ion Engines

Thruster D was shut off on November 4, 2009.

As counter measure Thruster-B combined with Neut-A generated enough thrust for the rest of the cruise.

The spacecraft was intentionally charged down to negative value, which made Neut-A emit electron current.



Malfunctions and Counter Measures on 2-prop Thrusters

Technology	Status	Counter Measures	Date
TCM	Loss of 2-prop Thrusters	Substitution of Ion Engines	Nov 2005 during Rendezvous